TRAFFIC ENGINEERING

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A NEW METHOD FOR COMPARING "BEFORE AND AFTER" ACCIDENTS

by HAROLD G. ECKHARDT, *Assistant Traffic Engineer*
Ohio State Highway Department

IN JUDGING the effectiveness or success of remedial measures for various traffic difficulties, most political subdivisions have indulged in simple "before and after" comparisons.

For instance, it appears that a favorable improvement has been achieved at a given location if, after that improvement, a reduction in accident frequency can be shown. If, on the contrary, the accidents following the treatment are found to be as severe or more so than those prior to the treatment the efficacy of the remedy is at least subject to question.

The installation of a traffic signal is generally expected to reduce angle collisions. Small satisfaction could accrue to the traffic engineer who announces a marked reduction in accident frequency at a signalized intersection only to realize that included in his "after" experience are several fatal or serious injury mishaps.

Obviously, there is a need for a better basis of comparison than merely quoting the number of accidents. It is, therefore, the purpose of this report to offer a severity index as an aid toward this end.

Granting that the element of chance is always present in that a fraction of a second or a fraction of a foot may be the difference between a very serious accident and one involving property damage only, cognizance must be taken of the fact that the same element will find its way into any comparison. If, however, a state-wide experience over at least a one-year period is studied, a normal or average should result.

The development of a severity index is relatively simple. It consists of examining each accident report, classifying each accident in one of several groups, expressing the total in each group as a percentage of the whole and finally computing the reciprocals of those percentages. The resulting reciprocals may then be used as factors, i. e.,

$$\text{Degree of Severity} = \text{Number of Accidents} \times \frac{1}{\frac{\text{Total Group}}{\text{All Accidents}}}$$

To each of four types of accidents is given an index, the sum of which would be the index for a given location over a given period of time. To arrive at any one of the four indices, follow the procedure outlined below:

Total number of accidents in a given year = 417

Total number of fatal accidents same period = 19

$$\text{Per cent of fatal accidents} = \frac{19}{417} = 4.55 \text{ per cent}$$

$$\text{Reciprocal of per cent} = \frac{1}{.0455} = 22.0$$

Therefore, value or weight of each fatal accident = 22.0

If over a given period there have occurred five accidents, one of which is fatal, one major accident, one minor accident and two property damage accidents, each of these accidents if assigned a calculated weight or index when totalled would give a severity index representing those five accidents.

To obtain the appropriate factor in Ohio, all the reported accidents that occurred at highway intersections outside municipalities during the years 1937 and 1938 were studied as to the extent of damage sustained. Those reported at intersections equipped with traffic signal control equipment were intentionally deleted so that any influence such equipment might have had would not affect otherwise normal conditions. Each accident was placed in one of the following groups:

1. FATAL—in which one or more deaths occurred.
2. MAJOR INJURIES—in which broken bones or other serious personal injuries were sustained.
3. MINOR INJURIES—sprains, slight cuts, bruises, etc.
4. PROPERTY DAMAGE ONLY.

The table below shows the number, percentage and reciprocal (or index) for each group and the state-wide index for 1937, 1938 and for a combination of those years. It will be noted that minor variations occur within each group for the separate years which, in the absence of compulsory reporting, might be expected.

TABLE SHOWING DERIVATION
OF
COMPARATIVE INTERSECTION ACCIDENT INDICES
FOR THE YEARS
1937, 1938 and 1937-1938 (Combined)
IN OHIO

		Group 1			*Group 2*			*Group 3*			*Group 4*			
	Total No. of Acc.	Fatal			Major Injury			Minor Injury			Prop. Damage			Index Sum of Reciprocals
		No.	%	R	No.	%	R	No.	%	R	No.	%	R	
1937	548	24	4.38	22.8	57	10.40	9.6	121	22.08	4.5	346	63.13	1.6	40
1938	417	19	4.55	22.0	48	11.51	8.7	137	32.85	3.4	213	51.07	2.0	36
1937-1938 (Combined)	965	43	4.46	22.9	105	10.88	9.2	258	26.74	3.8	559	57.92	1.8	38
(Index Adopted)				23.0			9.0			4.0			2.0	

R = Reciprocal of Percentage

It is believed that in order to arrive at proper factors or indices the accident experience of the last two preceding years should be adequate. To go further back than two years might tend to give exaggerated values since accident experience apparently varies from year to year.

To illustrate the use of the factors obtained for this state the following table lists eight rural intersections in Ohio, each equipped with traffic control devices. The upper line shows the scoring or rating prior to the installation and the lower line the indices for each subsequent to the treatment. In each instance the "Before and After" periods are of an equal length of time.

TABLE SHOWING "BEFORE AND AFTER" SEVERITY INDICES AT EIGHT SIGNALIZED INTERSECTIONS IN OHIO

	Total No. of Acc.	FATAL No.	FATAL Index	MAJOR No.	MAJOR Index	MINOR No.	MINOR Index	PROP. D. No.	PROP. D. Index	Index
Inter. A										
Before	5	0	0	1	9	3	12	1	2	23
After	4	2	46	0	0	0	0	2	4	50
Inter. B										
Before	4	0	0	1	9	0	0	3	6	15
After	4	0	0	0	0	1	4	3	6	10
Inter. C										
Before	8	0	0	2	18	2	8	4	8	34
After	1	0	0	0	0	0	0	1	2	2
Inter. D										
Before	5	1	23	0	0	3	12	1	2	37
After	0	0	0	0	0	0	0	0	0	0
Inter. E										
Before	12	0	0	0	0	3	12	9	18	30
After	3	0	0	0	0	1	4	2	6	10
Inter. F										
Before	5	0	0	1	9	3	12	1	2	23
After	1	0	0	1	9	0	0	0	0	9
Inter. G										
Before	4	1	23	2	18	1	4	0	0	45
After	2	0	0	2	18	0	0	0	0	18
Inter. H										
Before	5	0	0	0	0	1	4	4	8	12
After	1	0	0	0	0	0	0	1	2	2

Intersection A, while showing a reduction in the actual number of accidents, would merit careful investigation because of the large increase in severity. Intersection B, although showing equal before and after frequency, indicates that the "after" mishaps have been less severe than before. Intersections C to H, inclusive, indicate that the treatments afforded has been effective and that the intersection situation improved.

It is believed that, while it may not provide a truly accurate measure of success of a remedial treatment, this method furnishes a more adequate means of comparison than has heretofore been used.

SPEED

by D. GRANT MICKLE

No one questions that speed regulation is one of the most important, difficult and controversial problems of traffic safety.

Speed "too fast for conditions," is a keen factor in traffic accidents. But there is still much controversy and little uniformity concerning methods for controlling it.

For more than three years a committee of the National Safety Council has been studying as a factor in accidents and methods of speed control. Much data has been gathered regarding accidents in which excessive speed was reported and some conclusions have been reached as to the best ways of regulating speed without crippling transportation.

The committee's studies show that speed, aside from its very evident effect in increasing the severity of accident results, is an important factor in accident causation. Speed, as an accident factor, varies all the way from a problematical 100 per cent to a merely chance addition to an already hazardous situation.

Despite the wide differences in its responsibility in individual accidents, the importance of controlling this factor in accident occurrence is proved by the results that control measures have obtained in bringing about safer highway use.

Regulation of speed vitally affects a basic element in our vastly important highway transportation system. It is essential to balance carefully the hazards which may result from speed against the apparent speed requirements of traffic for the purpose of obtaining the best combination of safety and celerity of movement.

There are three general types of speed regulation provided for by the laws of most states. In the first place, there is a basic rule which provides that "no person shall drive a vehicle on a highway at a speed greater than is reasonable and prudent under the conditions."

Then there are usually numerical speed limits which name maximum speed permitted in certain enumerated general types of districts.

Finally, though not universally, there are special speed control zones with geographical speed limits—established by designated officials under the authority of the state law.

Although the exact wording varies, each state has on its statute books some statement of the so-called "basic rule." But there have been wide differences in the action taken regarding general speed limits and the authority to establish limited control zones.

Starting with absolute limits, set at what now seems rather low numerical levels, the practice in general speed limitation has undergone and is still undergoing radical change. Absolute limits have an apparent advantage from the enforcement point of view. All that is necessary to obtain a conviction is to prove that the speed limit was exceeded, with no fancy arguments about other conditions.

But with the improvement of highways and vehicles and higher standards of driver skill and driver understanding of the mutual responsibilities of highway use, low absolute limits became an impediment, not only to efficient transportation but to good enforcement.

Changes in general speed limit laws to remedy this situation have been of two kinds often combined. In the first place, numerical limits applying to rural trunk lines were raised, or in some cases eliminated entirely. In the second place, absolute limits were changed to prima facie limits.

A law setting prima facie limits imposes on a driver charged with involvement in an accident or with creating a hazard, and who has exceeded the limit, the responsibility of proving that he was driving carefully and prudently for the conditions.

Conversely, the prima facie law imposes on the enforcement officer the responsibility of proving that a driver so charged, but who was driving within the limit, was handling his car carelessly and imprudently, considering conditions. With prima facie limits, the violation consists in creating a hazard. With absolute limits, it consists in exceeding a set numerical speed value. The numerical limit is chosen on the basis of normally favorable conditions of traffic and roadway, but of course there are many locations in which such favorable conditions do not exist.

In establishing speed control zones, problems of the utmost difficulty and complication are often presented, requiring a special technique for their solution. A suggested technique is outlined in the 1938 Report of the Committee on Speed Regulation.

Condensed from an article by D. Grant Mickle, Traffic & Safety Engineer, Michigan State Highway Department (Vice-President, I.T.E.). PUBLIC SAFETY, May 1940, pp. 10, 11, 41.

MOVING THE MASSES IN MODERN CITIES

by CHARLES GODRON

ONE of the most important problems of the modern city is that of improving its circulatory system. There is little difference of opinion as to the causes of the difficulties which confront us. American cities have simply grown faster than have facilities for handling the increased volume of local travel. As a result it is becoming increasingly inconvenient, costly and dangerous to move about, with a consequent tendency for business to shift to new locations.

Lack of general public understanding of the fundamentals of these problems and their significance has resulted in a natural tendency to assume that we shall all ultimately move about in private automobiles. Artists have painted beautiful pictures of the cities of the future, with their towering pinnacles and connecting skyways along which are to flow myriads of individual automobiles. Their spectacular nature appeals readily to popular imagination with a result that such proposals are not always critically examined to determine the extent to which they are based upon sound technical and economic considerations. Such examinations would, in the opinion of the transit industry, direct attention to the importance of giving far greater consideration than many current plans envisage to the development and improvement of the vital public carriers.

Except in the larger cities where rapid transit lines have been built, surface streets are the principal arteries of urban travel. Over these streets two general types of vehicles are operated, public vehicles—street cars, trolley coaches, buses and taxicabs—and also, privately owned automobiles. Direct comparisons can be made of the relative efficiency with which these streets are used by the different vehicles, either in terms of vehicles or persons. But, since the economic and social life of cities does not depend upon the movement of vehicles, but upon the people in those vehicles, it is the latter that are the primary concern. *Vehicles are merely a means to an end.*

VEHICLE & PASSENGER CAPACITY - CITY STREET
60 FT. PAVEMENT - 3 LANES EACH DIRECTION - NO PARKING

	VEHICLE CAPACITY		PASSENGER CAPACITY		TOTAL PASSENGERS
	AUTOS	BUSES OR STREET CARS	AUTOS	BUSES OR STREET CARS	
AUTOMOBILES ONLY	2115	—	3700	—	3700 ALL SEATED
AUTOS & BUSES	—	—	2130	7200	9330 ALL SEATED
	1215	180	2130	9000	11,130 SEATED & STANDING
AUTOS & STREET CARS	1215	150	2130	9000	11,130 ALL SEATED
	—	—	2130	13,500	15,630 SEATED & STANDING

CHART 1

Therefore, to obtain a true perspective of the problem, it is essential to measure the capacity of surface streets in terms of the number of people served. This has been done in Chart 1 showing, first, maximum vehicle capacities in one direction of a 60 foot pavement with parking prohibited, followed by passenger capacities, under various conditions of use.

As the chart shows, a 60 foot street used jointly by mass transportation and automobiles provides an artery for the movement of from three to more than four times as many people as does the same street when used exclusively by private automobiles.

To overcome the limitations of surface streets both in speed and capacity, it is proposed to build multiple-deck highways so as to avoid grade crossing interference. Thus, it has been assumed, we can provide our imaginary cities of the future with ample highway capacities so that workers and shoppers may drive themselves comfortably in swiftly moving streams of individual vehicles through the lofty buildings that will pierce the sky in what are now congested business areas.

But there are difficulties in the way of making these dream pictures come true. A city street with two lanes of free-moving automobile traffic in each direction, subject to normal grade crossing interference, has a maximum capacity in each direction of approximately 900 vehicles per lane per hour under modern methods of traffic control and regulation. The best that can be expected from an elevated highway or depressed roadway is about 1500 per lane.

On such a skyway, however, traffic will move at higher speeds and in that respect the transportation will be more satisfactory to the user. But capacity, in terms of vehicles per hour, does not increase in proportion to speed past a given point. As shown in Chart 2 there is a critical speed of between 30 and 35 miles per hour at which the maximum number of vehicles can move on such a highway. These are theoretical maxima, based upon short time counts, which exceed by about one-third the practical capacities attainable on such roadways. For speeds such as are talked about on these highways, say of the order of 50 miles per hour, capacity declines to little more than that at 15 miles per hour.

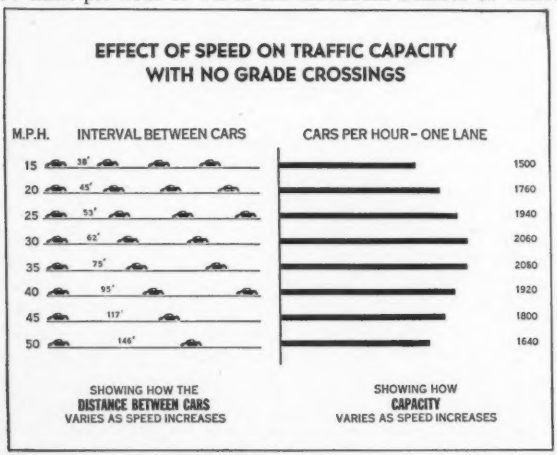

CHART 2

Chart 3 sets up a direct comparison of the relative passenger capacities per single lane of all known methods of moving people in congested areas. It shows that the passenger capacity of a lane of buses on a surface street is about three and one-half times that of a lane of automobiles on an elevated highway while street cars on a surface street have a capacity about five times that of private vehicles on the grade separated roadway.

A combination express and local subway system will carry, at a reasonable standard of loading—considerably below that common in New York City—a total of 100,000 passengers per hour in one direction on two tracks. Cost of

such construction would range from $6,000,000 to $18,000,000 per mile but it would have a capacity equivalent to nearly 20 four-lane elevated highways filled to their maximum capacity with private automobiles.

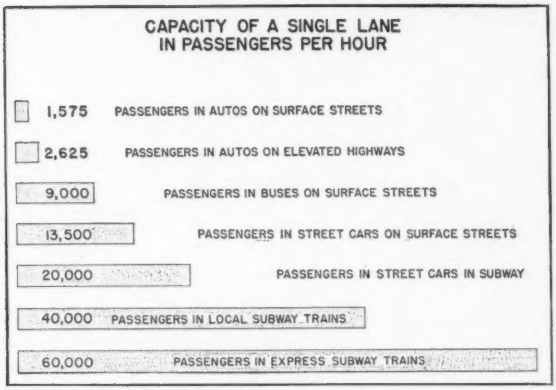
CAPACITY OF A SINGLE LANE
IN PASSENGERS PER HOUR
1,575 PASSENGERS IN AUTOS ON SURFACE STREETS
2,625 PASSENGERS IN AUTOS ON ELEVATED HIGHWAYS
9,000 PASSENGERS IN BUSES ON SURFACE STREETS
13,500 PASSENGERS IN STREET CARS ON SURFACE STREETS
20,000 PASSENGERS IN STREET CARS IN SUBWAY
40,000 PASSENGERS IN LOCAL SUBWAY TRAINS
60,000 PASSENGERS IN EXPRESS SUBWAY TRAINS

CHART 3

But there is still another factor to be considered. Assume that highways can be built in cities so that all workers and shoppers can transport themselves in their own automobiles, and that they can afford to do so. Before these people can function, there must be space for the vehicles which they drive. All agree that storage space for such vehicles cannot be provided on surface streets but in off-street areas and buildings.

Studies of office space allocated to each person in modern buildings and garage storage space requirements of automobiles shows that the space required in garages approximately equals that required in central area business buildings by the people who ride in them.

Thus to transport the daily working population into central areas by automobiles would require double the cubage requirements of present central areas. This comparison makes no allowance for the storage of cars by those who come to the district for purposes of business and shopping. It considers only the space requirements of those who work in the area.

Despite the phenomenal increase in the ownership of private automobiles, public transit continues to play an important part in the life of modern cities. Chart 4 shows graphically the relation between the number of rides per day on public transit lines and the total population of cities in various size groups ranging from 25,000 upwards. In cities of over 1,000,000 population the daily number of transit rides is approximately equivalent to the total population; this relationship declining as the size of the cities decreases. To perform this service the American public pays, annually, for local transit service an amount exceeding the total passenger revenus of Class I railroads, all inter-city bus lines and the air lines of the country combined.

Through many developments such as the P. C. C. car, electrically-propelled trolley buses, diesel-powered buses and improved methods of power transmission through the use of hydraulic drives, transit is trying to meet the demand for improved urban transportation. This objective can be fully achieved only if the importance of public transit service in modern cities is recognized by leaders of public thought. The future part which any mode or vehicle of urban transportation is to play must be judged on the basis of its economic and social value to the community. The demonstrable economic advantage of collective trans-

portation justifies the conclusion that development of such facilities and their utilization to a greater extent than at present, a community may most economically achieve needed improvement of traffic conditions.

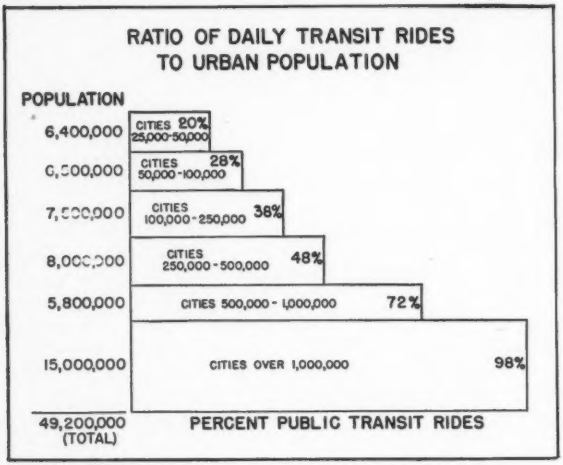

CHART 4

Compared to the cost to a community of rebuilding itself for automobile travel, the economic advantage is all in favor of whatever public expenditures may be necessary to achieve a really acceptable standard of service on public carriers.

Condensed from a pamphlet by Charles Godron, Managing Director, American Transit Association, New York, N. Y., 32 pp., 10c.

NEW TECHNIQUES IN TRAFFIC BEHAVIOR STUDIES

by E. H. HOLMES *and* S. E. REYMER

Significant advances in the technique of studying traffic movement have been made during the past year. New devices have made possible the collection of data needed in studies of highway capacity simply, accurately, and far more cheaply than has heretofore been possible. These devices also have opened entirely new fields of study of the requirements for safe operation of vehicles on our highways.

The requirements of a new method were definitely established on the basis of the earlier experience. The major requirements were as follows:

1. The speeds of all vehicles must be measured.

2. Each speed measurement must be recorded.

3. The time spacings between vehicles must be determined and recorded.

4. The process of determining and recording these items for each vehicle must be completed in less than 1 second.

5. The records must permit segregation of data by traffic lanes, and the direction of travel of each vehicle must be indicated.

6. All measurements and recordings must be entirely automatic, because of the anticipated widespread application of the method.

7. Speeds must be measured with an error of less than 5 per cent within the normal range of vehicle speeds.

An extensive survey of existing methods of speed detection revealed that none of the available devices would satisfy all of the requirements

and, accordingly, an entirely new mechanical-electrical device was developed. Development work by the Public Roads Administration resulted in the production of an entirely new speedmeter incorporating a pneumatic detecting unit, an electromechanical timing unit, and either of two types of recording units.

Either of two types of recording units may be employed with the timing unit. One type consists of a standard 20-pen graphic time recorder which utilizes a strip chart. By using a novel circuit arrangement made possible by an additional level of contacts on the Strowger switch, the 20-pen recorder was virtually converted into a 39-pen recorder. The second type of recording unit consists of a bank of 20 counters of the type employed as telephone call registers. Each counter is individually connected to a separate group of contacts, ranging from 1 to 4 contacts per group, on 2 levels of the Strowger switch. In contrast with the other recording unit, this type does not record indiviual speeds but simply accumulates the group speeds on series of counters. No provision is made for indicating direction of travel although the circuit arrangement permits the use of the manually controlled direction-reversing key.

Simultaneously with the development of the speedmeter, a device by which the transverse positions of vehicles on the pavement could be automatically recorded was being developed. Such information is needed for two purposes: (1) to determine economical lane widths for various speeds and types of traffic; and (2) to study the behavior of traffic under various highway and roadside conditions. These two purposes are closely related, yet entirely distinct from one another.

Analysis of the transverse positions of vehicles on the highway requires a delimiting of their paths. Under normal conditions, with no interfering traffic, vehicles will travel at such distances from the center or edge of the pavement as the inclinations or habits of the drivers dictate. It is to be expected that the majority of vehicle paths will be concentrated on a portion of the pavement only slightly wider than the average car. If the few extreme cases are excluded, the area along the pavement traversed by the remaining large majority of the vehicles will define the vehicle path on that particular highway.

The determination of the most appropriate combination of lane width and shoulder width and type on normal tangent alinement is thus the first purpose of these studies. The second main purpose is to discover the effect on normal driving practice of curves of varying degrees, of the presence of roadside objects such as guardrails, narrow culverts, and other objects encroaching on the normal shoulder width, and of high curbs, overgrown shoulders, or other features which may have a considerable psychological effect on the driver.

These studies are directed toward economy of highway construction, for they will show, not only how wide traffic lanes should be, but also how narrow they can be, and whether the use of paved shoulder may have the effect of a greater lane width by inducing vehicles to travel nearer the edge of the pavement. They will also have an equal if not greater value as a means of studying traffic safety, particularly as it is affected by highway design.

As a result of this development work, there are now available and in operation three distinct types of apparatus adapted either for use independently or in combination with one another. The first is the speed counter with which vehicle speeds may be determined and their records accu-

mulated on a series of counters. This device is useful where general observations of traffic speed are desired. Average speeds and speed distribution may be determined accurately, the results being available almost immediately upon completion of the field work. Typical uses are found in studies of the effect on speed of highway lighting, of enforcement policies, or of various features of the highway design in which the identification of particular vehicles is unimportant.

The second type of apparatus is the speedmeter, with which the speed of each vehicle may be measured and, by means of a related graphic recorder, individually and automatically recorded. It is more precise in its record than the speed counter, and is useful wherever the speeds of individual vehicles must be identified. The results may be obtained only after the chart records have been transcribed in the office. The feature of individual vehicle recording is essential in a study of highway capacity.

The third type of apparatus is the placement detector with which the transverse positions of all vehicles are separately recorded. Since speed is expected to be a factor in vehicle placement, this device is invariably used in combination with the speedmeter.

The speed records collected in conjunction with the placement records are those needed in an analysis of highway capacity. Similarly, if the placement detector is used in conjunction with the speedmeter at the locations where studies of highway capacity are being conducted, information on vehicle paths will be automatically collected as a by-product of the capacity study. It has been customary, therefore, to collect complete information on both phases of the work at every location studied, regardless of the primary purpose of the operation at any particular spot.

In addition to satisfying these primary requirements, the equipment has made possible a variety of studies not heretofore possible because means of conducting them had been inadequate or completely lacking. Among special purpose studies that have been considered but on which work has not yet been undertaken are the following.

1. *Effect of curvature and superelevation* — The degree of curve that can be permitted and the superelevation that must be introduced in order to encourage vehicles to negotiate curves without tendency to deviate from their proper traffic lanes may be readily studied with this equipment.

2. *Effect of spiraling.* — By installing the speed and placement detectors at various points along curves and for short distances preceding or following them, the effect of any such treatment may be evaluated. This type of study may be based upon a determination of the average paths of all vehicles at the different points or, by some modification of the apparatus, the paths taken by particular vehicles as they traverse the curve may be observed.

3. *The effect of vehicle length.* — The extent to which long vehicles or combinations such as tractor-truck semi-trailers tend to track off line and thus require additional pavement width on curves, whether proper superelevation will eliminate this effect, or whether side slippage of the rear wheels of a trailer, under certain conditions, might have the reverse effect, can be readily determined. In addition to determining the speeds and positions of such vehicles, the wheelbase lengths may also be recorded without requiring that any vehicle be stopped or otherwise measured.

4. *The effect of special design features, as at intersections.* — The areas of pavement used by vehicles in negotiating intersections or other special highway design features may be investigated by the placement detectors

to assist in eliminating unused areas in future designs.

Mechanization of the field procedure has virtually eliminated the personal element in the accuracy of the recording, an important factor in work that is rapidly expanding and consequently must be performed by many different individuals. Further, the standardized equipment not only improves the accuracy of the particular studies, but insures that all studies will be made on a comparable basis. Of great importance also, is the reduction in cost. Field work under this new procedure costs less than one-third, and analysis less than one-fourth, the cost of earlier methods.

Condensed from an article by E. H. Holmes, (Assoc. I.T.E.) Highway Engineer-Economist, and S. E. Reymer, Assistant Research Engineer, Public Roads Administration. PUBLIC ROADS, April 1940.

TRENDS IN MODERN HIGHWAY PRACTICE

by MURRAY D. VANWAGONER

PERHAPS the most powerful influences in shaping American highway practice have been the motive force of increasing traffic and the braking effect of fiscal limitations. In less than 40 years, the numberof motor cars has grown from practically zero to 30 millions of registered vehicles, and motor travel has increased to 250 billions of vehicle-miles annually. Year by year, the maximum potential vehicle speed has risen and is now above 80 miles an hour.

Throughout the period of highway development, however, the amount of funds available has been a limiting factor, and more recently changes in the sources and distribution of highway revenues have brought about a very critical situation. General revenues have been steadily withdrawn from highway support, and motor-vehicle revenues have been spread more and more widely over the entire road and street mileage. A considerable part of the latter funds has been diverted from highway use.

Several states have stopped diversion by constitutional amendments but there is no sign that local support of local roadways will be completely restored or that mileage of highways and streets over which motor-vehicle revenues are now distributed will be materially decreased. As for increasing revenues by raising motor-vehicle tax rates, the fact that half our car owners have an income of $1,500 or less indicates that such a policy would be unproductive if carried beyond reasonable limits.

Probably the most potent influence in laying a sounder foundation for highway policy and practice is the practically nation-wide study being made by the highway planning surveys. Cooperatively sponsored and directed by the Public Roads Administration and the highway departments of 46 states, these projects have dug out the facts about highways, their traffic, and their financial support.

The first requirement of sound highway development is the determination of those portions of the roadway system on which the expenditure of available highway revenues will best serve the purposes for which they were collected. The present tendency to withdraw all support from the highways except that derived from motor-vehicle taxes, points to the car owner as the one who should properly be benefited.

Total highway needs may be expressed in terms of the financial outlay required to keep intact the existing three million miles of highways and streets. In general these critical highway needs will exist on the motor

transport system made up of primary and secondary roadways regardless of what jurisdiction these roadways may be under. We must think in terms of a physical operating plant and not in terms of the units of government that may by accident or otherwise be responsible for its various elements.

The principal objective of highway planning should be to determine primary and secondary roads and streets having the utmost significance in motor-vehicle transportation regardless of whether they are under the jurisdiction of the city, the county, or the state. Obviously a great many miles of purely local roads and streets, where no traffic problems exist, must be excluded from consideration.

The distribution of travel on various classes of roads in 17 states is of value in determining which roadways are of greatest service to transportation. The Public Roads Administration presents the following figures:

System of Roadways	Percent. of Tot. Rd. Mileage	Percent. of Tot. Rd. Travel
Trunk lines, rural and urban	16%	60%
Local City Streets	6%	30%
County and local rural roads	78%	10%

In Michigan, our highway planning survey showed that 14% of the rural trunk-line mileage carried 44.5% of all trunk-line travel; that 55% of all urban vehicle-miles were produced on streets which are the urban connections of federal and state highways; and that 10% of non-trunk-line rural roads carry nearly 60% of non-trunk-line rural travel.

It is on these heavily travelled rural routes and urban arteries that the revenues from motor-vehicle taxes will for the most part be expended under a just and rational highway plan. It is a mistake to believe that to concentrate effort on a strategically selected system rather than to spread it over the total road mileage will work any hardship to traffic. In the one case actual highway benefits are widely and intensively provided; in the other, highway utilization may be just as great, but the benefits are of a much lower order.

In its exhaustive study of fatal accidents, the Michigan highway planning survey has revealed that suburban sections of trunk lines are the rural "hot spots." The fact that 34% of all trunk-line accidents involving a pedestrian fatality occur within the first mile, indicates that consideration must be given to sidewalks and highway lighting in some of the most critical areas. Concentration of vehicle collisions at an intersection give strong hints that a grade separation is required. Where serious accidents reach a high frequency between intersections it is good evidence that the capacity and perhaps the type of the pavement is unsuitable for its traffic.

Analysis of accident occurrence also give very definite information as to the volumes of traffic that can be safely accommodated on divided highways and on pavements of 2, 3, and 4 adjacent lanes. These indicate that the two-lane pavement is satisfactory for average traffic loads up to 3,500 cars a day. Similarly, the three-lane pavement is fairly adequate for average daily volumes from 3,000 to 5,500 vehicles. In no volume range is the four-lane highway safer than the other two undivided pavements and in most ranges it is definitely more hazardous. By contrast, the divided highway revealed an insignificant fatal-accident rate under all volumes observed. These results aid in determining not only the suitable type of pavement for existing traffic, but the stages by which the roadway should be expanded for traffic growth.

Width of lane is of hardly less importance to highway safety than number of lanes. Observations have led to the conclusion that the ordinary

1939 PROCEEDINGS

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10-foot lane is too narrow for highways carrying large volumes of traffic. This is even more true where there are many large-dimension, slow-moving units. Under these conditions, the minimum over-all width of two lanes carrying one-directional traffic should be 23½ ft. whether on a divided roadway or on half of an undivided four-lane pavement. The added width should go to the left-hand or inside lane, since it is there that the critical overtaking and passing maneuvers of the faster cars take place.

It is well to keep in mind that highway income must be in the future, as it has been in the past, a controlling factor. Under the immense pressure of a fast-growing motor transportation, funds were provided liberally from the general public purse and from special vehicle charges. With these has been created what is perhaps the greatest highway system the world has known. Because of its great extent, many think the job is done. The engineer and the highway administrator know that the highway job will never be done; that the plant brought into existence to serve useful social and economic purposes must be perpetuated by replacements and maintenance, and must be operated. Furthermore, it must be expanded to keep pace with its growing usefulness.

Condensed from an article by Murray D. Van Wagoner, State Highway Commissioner, Michigan State Highway Department. CIVIL ENGINEERING, May 1940, pp. 291-294.

IS PEDESTRIAN SAFETY MERELY CONVERSATION?

by HARRY E. STEDMAN

THE pedestrian traffic accident problem is the most discussed angle of traffic safety. Safety Engineers know what to do but are paralyzed by lack of that public interest which would approve expenditures for safety measures. Safety pays big dividends, but it costs money. Citizens persist in thinking, "It can't happen to me; it won't happen here," while traffic accidents continue to happen.

The first essential is to know "how-where-when-why" the pedestrian accident happens. This is discovered from pedestrian accident spot maps and complete records. Then, whose accident is it? By this I mean, you would not treat an intersection that was adjacent to an elementary school the same as you would a loading zone for street cars in front of a Home for the Aged. They are different problems.

What caused the accident?

1. Was it lack of street lighting? Are the accidents occuring at night? Is the lighting well arranged? Does it put the pedestrian crossing the street in silhouette? Is there glare in the motorist's eyes from some flood system on private property.

2. Is the roadway extremely wide and is vehicular traffic heavy? Is a traffic island necessary? It has been found that at uncontrolled intersections a motorist becomes confused if he has to find his way through more than four lanes of moving traffic without the protection of a safety island.

3. If the problem is a matter of mass moving of pedestrians across a mid-block location, the possibility of an overpass is suggested. In building under- or over-passes, it is well to remember that you must make them convenient and easy for the pedestrian to use; otherwise, they become a hazard.

4. At schools and intersections where mass movement of pedestrian traffic is a problem with a minimum of cross vehicular traffic, semi-actuated pedestrian control units are an aid.

5. In the use of traffic signals, a signal should be provided for the pedestrian. On wide streets a *walk* signal is desirable, so timed that it will warn the pedestrian of insufficient time to cross.

6. Crosswalks and paving markings are a very definite help. We have 150 school intersection crosswalks marked with white cement. They definitely aid as a warning to the motorist.

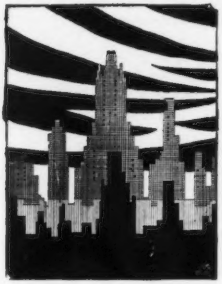
7. At the majority of our school crossings in residential areas we use a rotating school stop sign which is turned to face toward traffic three hours each school day at the times that the students are going to and from school. We require all traffic to stop at these locations.

8. Signs as pedestrian aids have been helpful at a number of intersections in our city. In some places we use metal signs with the message, "Watch Traffic Signal"; in other places we paint the message on the sidewalk.

9. At many intersections it may be necessary to prohibit vehicular turning movements, because of heavy pedestrian traffic. Education and enforcement are essential. At the twenty most hazardous pedestrian accident corners in the city we have posters covering accident problems.

We must remember when we get out of our car *we are pedestrians*, and, as such, we cannot expect the motorist to do the impossible as a *driver*.

Condensed from an article by Harry E. Stedman, City Safety and Traffic Engineer, Des Moines, Iowa (Assoc., I.T.E.). AMERICAN CITY, May 1940, pp. 93, 95.



Traffic Engineering NEWS

NEW APPOINTMENTS TO TRAFFIC ENGINEERING STAFF

President Simpson has appointed the following men to the TRAFFIC ENGINEERING staff:

Special Associate Editor: Lawrence B. Tipton. Mr. Tipton will assist Editor Greenshields in securing original articles, abstracting material, and in editing TRAFFIC ENGINEERING.

Advertising Manager: Thomas J. Seburn. Mr. Seburn will take complete responsibility for the solicitation of advertising.

Circulation Manager: Bernard C. Hartung. Mr. Hartung's duty will be to increase the circulation of TRAFFIC ENGINEERING.

Midwest Safety Conference

The traffic sessions of the Eighteenth Annual Midwest Safety Conference, arranged by an Institute committee headed by Leslie J. Sorenson and William R. Abbott, Jr., were an outstanding success. The meetings were exceptionally well attended and the speakers covered a broad range of subjects.

On May 1 a special luncheon for Institute members was held in the Sherman Hotel. The luncheon was followed by an informal discussion of the Institute's policies and matters regarding the affairs of the Institute.

After the conclusion of the meetings, the following letter was received by the Institututе's local committee from George G. Traver, Manager of the Greater Chicago Safety Council:

May 6, 1940

Gentlemen:

I can't tell you how very much I appreciate all you did for the Midwest Safety Conference. You certainly built up some fine programs for the Public Safety Sessions, and I don't think there is any question that your part of the program was the best we have ever had, both in quality of program and in interest and attendance at the sessions.

Will you extend my personal thanks and appreciation to the officers, directors, and members of the Institute of Traffic Engineers for their part in this conference.

Sincerely,

George G. Traver, Manager

GGT:OP

CHECK YOUR FILES

1. Check the mailing address on the envelope. Is it correct?
2. Have you been receiving your copies of TRAFFIC ENGINEERING?
3. Have you received your Roster, sent out within the last month?
4. Have you received your copy of the *1939 Annual Proceedings?*
5. Have you received your membership card?

More on Early Traffic Signals

One of the world's earliest street traffic-control devices was set up in London a little more than 70 years ago this month. Troubled by what they called "ungentry" overflowing the streets and hawking vegetables, the city officials hired a firm of railway-signal manufacturers to devise a control. The traffic director consisted of a 20-foot tower topped with a gas lamp, which was arranged to shine green for "caution" and red for "stop." As a further safeguard it was fitted with two mechanical arms that could be lowered to halt oncoming traffic. On December 8, 1868, one of the London papers commented that the contraption was "obviously an improvement upon the gesticulations of a policeman as a defense against accident." — BETTER ROADS, Dec. 1939

Traffic Safety Training Institute

The National Traffic Safety Training Institute will be held in Knoxville, Tennessee, August 12-24. Mr. D. Grant Mickle, Vice-President of the Institute of Traffic Engineers, will speak to all attending the course at the opening session. Mr. Mickle will also lecture at one of the other sessions. Dr. Miller McClintock, (Mem. I.T.E.), Burton W. Marsh, (Mem. I.T.E.), Sidney J. Williams, (Mem. I.T.E.), Maxwell N. Halsey (Mem. I.T.E.), and several other Institute members will also take part in this Traffic Safety Training Institute.

University of Texas

Announcement has been made of a Conference in Traffic Engineering sponsored by the College of Engineering of the University of Texas, July 15th to July 20th, inclusive. The conference, which is under the direction of Mr. John A. Focht, professor of highway engineering of the University of Texas, is the first gathering of this type to be held in Texas. The conference is opened to all public officials in the United States and Mexico.

A group of state and national traffic authorities will lecture on the following subjects: Accident Reporting; Principles of Traffic Engineering; Speed Studies and Speed Zones; Geometrics of Street and Highway Design and Redesign; Channelization of Motor Traffic Flow; Signs and Pavement Markings; Street and Highway Lighting; Highway Economics; Traffic Signal Lights; Traffic Psychology; City Planning; Traffic Safety Education; and Traffic Enforcement.

Activities of Members

Wilbur S. Smith (Assoc. I.T.E.), has left the South Carolina State Highway Department on a leave of absence basis for one year to accept a position on the staff of the Yale Bureau for Street Traffic Research. Mr. W. W. Dibble (Jun. I.T.E.), will act as Traffic Engineer of the State Highway Department in the absence of Mr. Smith.

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NEW MEMBERS AND TRANSFERS

The Institute of Traffic Engineers welcomes the following new members and congratulates four members receiving a transfer in grade:

Name and Address	*Board Action*
C. C. Clark Junior Engineering Aid in Traffic City of Cincinnati, Ohio	Junior
E. F. Clark, Ass't Civil Engineer In Charge of Traffic New York State Division of Hwys Babylon, New York	Member
J. B. Ecker, Research Engineer Capital Transit Company Washington, D. C.	Associate
M. O. Eldridge, Assistant Director of Traffic District of Columbia Washington, D. C.	Member
Harry Porter, Jr. District Traffic Engineer Illinois Division of Highways Chicago, Illinois	Associate
M. C. Sielski, Ass't Traffic Engineer Chicago Motor Club 66 East South Water Street Chicago, Illinois	Junior
M. C. Stark, Research Assistant Capital Transit Company Washington, D. C.	Junior
A. J. Watson, Jr. Junior District Traffic Engineer Penna. State Highway Department Pittsburgh, Pennsylvania	Junior
J. W. Welsh, Senior Engineer Ford, Bacon, & Davis 39 Broadway New York, New York	Member
E. G. Wetzel District Traffic Engineer State Hwy. Commission of Indiana Seymour, Indiana	Associate
E. B. Williams, Chief Traffic Engineer St. Louis Public Service Co. 3869 Park Avenue St. Louis, Missouri	Associate

Affiliate Membership Nominations

L. B. Yost — Board invitation to become an Affiliate
Public Relations Department
General Motors Corporation
1775 Broadway
New York, New York

Transfers

L. E. Bender, Fellow — Transfer from Junior to Associate
Bureau for Street Traffic Research
Yale University
New Haven, Connecticut

C. S. Cunningham, Traffic Planner — Transfer from Associate to Member
Bureau of Traffic Planning
908 City-County Building
Pittsburgh, Pennsylvania

J. B. Moriarty, Traffic Engineer — Transfer from Junior to Associate
State Hwy. Commission of Indiana
Indianapolis, Indiana

W. H. Voltz — Transfer from Associate to Member
Electric Signal Design Engineer
Bureau of Traffic Planning
617 Second Avenue
Pittsburgh, Pennsylvania

NOTE: *Please cut these pages out and paste them in your Roster.*

Annual Convention of I.M.S.A.

One of the features of the Annual Convention of the Southwestern Section of the International Municipal Signal Association at Houston, June 20-22 will be a traffic engineering panel discussion. The panel is to be composed of Virden A. Rittgers, (Assoc. I.T.E.), Thomas E. Willier, (Assoc. I.T.E.), Robert O. Swain (Jun. I.T.E.), Walter H. Klapproth (Mem. I.T.E.), and H. S. Phillips.

Information Please

Mr. Thomas E. Willier, Houston's new traffic engineer, (Assoc. I.T.E.) is having trouble with paint lines. Mr. Willier says that Houston's moist climate at night makes it necessary to apply paint before 10 P. M. He seeks advice from other coastal cities.

San Antonio, Texas

The office of Virden A. Rittgers, San Antonio traffic engineer, (Assoc., I.T.E.) has been expanded to include one secretary, one drafstman, one statistician and five traffic checkers. Mr. Rittgers has gained local fame by solving the traffic congestion problem at Romana Plaza, one of San Antonio's worst traffic locations. Complete details of this installation are to appear in the June issue of the *American City*.

An Index for Volume X of TRAFFIC ENGINEERING, covering a period of April 1939 to April 1940, will be included in the June issue.

Attention Members!!

THE ELEVENTH ANNUAL CONVENTION INSTITUTE OF TRAFFIC ENGINEERS

Chicago, Illinois - October 5-8, 1940

STEVENS HOTEL

Arrangements have been made with the Stevens Hotel to have all of the members of the Institute and their wives lodged on one floor. In order to carry out effectively this plan and secure our share of low rate rooms as well as the best floor in the Hotel, it is necessary for us to get our reservations *in early*. Please send your reservations to:

MR. W. R. ABBOTT, JR., Chairman
Convention Arrangements Committee
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